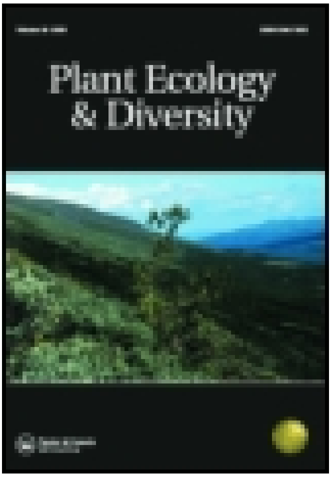

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II. Recent Botanical Intelligence

Professor Balfour

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the top of the root. The whole plant has a strong garlic odour.

The communication was illustrated by a flowering branch of the plant, with its leaves and sheathing petals, as well as by stereoscopic photographs taken by William Walker, Esq., F.R.C.S.E.

II. *Recent Botanical Intelligence.* By Professor Balfour.

1. Braun *on Parthenogenesis.*

Dr Balfour gave a rapid sketch of the progress of vegetable embryogeny, from the times of Grew, Ray, Camerarius, Linnæus, and Morland, up to the present day. He then gave an abstract of Dr Braun's statements in regard to Parthenogenesis, or the production of perfect seed without the agency of pollen.

The doctrine of reproduction in plants and in animals by the agency of two sexes has been so generally received, that it has become a physiological character in the organized kingdom of nature. Of late years, however, facts have been produced, which seem to prove that reproduction may take place in certain instances without fecundation. To this Siebold has given the name of Parthenogenesis, or virgin-birth. This has been demonstrated in a very interesting manner by Siebold, in the case of bees, and of some butterflies (Wahre Parthenogenesis bei Schmetterlingen und Bienen, von Th. von Siebold, 1856). Various experiments have also been made on diclinous, especially monœcious plants, which seem to show a similar mode of production in the vegetable world. The earliest observations appeared to be so completely at variance with the received doctrine of science, that they were discarded, and the facts, as narrated, were referred to some error or fallacy in the experiment. The difficulty of isolating the flowers of plants, and preventing the contact of a single grain of pollen, was so great, that botanists were cautious in giving assent to the facts which seemed to be proved by the experiments. These remarks apply to the observations of R. J. Camerarius in 1694, of Spallanzani from 1767 to 1779, of Henschel in 1817–18, of Girou de Buzareingues in 1827 to 1833, of Ramisch in 1833–38, and of Bernhardi in 1834–39. Within the last few years, however, the experiments of Tenore, Gasparrini, Naudin, and Smith of Kew, seem to place the doctrine of vegetable parthenogenesis beyond doubt.

The following are the plants on which the most direct and positive observations have been made :—

A. *Diœcious Plants.*

1. *Cannabis sativa*, common hemp.
2. *Spinacia oleracea*, common spinach.
3. *Lychnis dioica*, common campion.
4. *Mercurialis annua*.
5. *Bryonia dioica*, bryony.
6. *Datisca cannabina*.
7. *Pistacia narbonensis*, and other species of the genus.

B. *Monœcious Plants.*

8. *Cucurbita Melopepo*, and other species of the genus.
9. *Cucurbita Citrullus*, water melon.
10. *Urtica pilulifera*, Roman nettle.
11 *Ficus Carica*, fig.

All the observations, however, made on these plants have not been rigorously demonstrative, inasmuch as due precautions have not in all instances been taken to prevent the access of pollen from some extraneous source, nor to determine whether or not some male flowers may not have appeared among the female ones. At the same time, it must be admitted, that when such careful and able observers as Spallanzani, Bernhardi, Naudin, and Thuret, deduce the same results from experiments made without any preconceived ideas, their opinion bears strongly in favour of the existence of parthenogenesis.

In order to put the matter beyond doubt, Braun remarks, it was necessary that we should have an exotic diœcious plant of which there was only female and no male specimens in our gardens, and in which it could be shown that there was no tendency to produce male flowers among the female ones. These conditions seem to be fulfilled by the plant called *Cœlebogyne ilicifolia.*

In 1829, Allan Cunningham sent to the garden at Kew three specimens of a small shrub, with holly-like leaves, which he had found growing abundantly in the forests of the Brisbane River at Moreton Bay. The plant produced female flowers, and was found to be Euphorbiaceous. It first received the name of *Sapium ilicifolium* and subsequently of *Cœlebogyne ilicifolia.* The plant was found to have produced perfect seeds, in circumstances where pollen could not have come into contact with the pistil. The plants produced by the seeds were in every respect similar to the parent.

Since Mr John Smith's first observations at Kew opportunities have been afforded of experimenting carefully on the plant; and after twenty-seven years' observations, the fact, as stated by Mr Smith, appears to be confirmed.

In the Berlin garden similar observations have been made, and the results are confirmatory of those at Kew. In all cases female plants have been produced similar to the parent, and seeds have been perfected without the contact of pollen. Some of the seeds have been found by M. Braun to contain no albumen nor embryo, while others were perfect in every respect.

The question then comes to be, How are these seeds perfected?

1. Is there any fecundation in the plant by means of the glandular bodies, or otherwise?

2. How is the embryo formed, and what phenomena precede and follow its development, as compared with what takes place where pollen intervenes?

3. Is the Cœlebogyne really a plant of a single sex, as it appears to be in our gardens; or, if there are two sexes in its native country, what are the numerical relations of the individuals of each sex in the case of fertility without previous fecundation, and in the case in which the embryo is the necessary consequence of fecundation?

As regards the first question, it may be remarked, that effective fecundation without anthers or pollen is contrary to all probability among Phanerogams. M. Braun has examined the glands which occur on the external surface of the bracts, and has not been able to detect anything different from the glands of other Euphorbiaceæ.

As to the second question, M. Braun gives observations by M. Th. Deecke on the production of the embryo, in which he shows that the embryo follows the usual course of development in angiospermous Phanerogams, with the exception of the absence of the pollen tube. Radlkofer confirms these statements from observations made on more than twenty ovaries of the plant at Kew. The germinal vesicles which appear are either two or three, one of which comes to perfection. Thus, says M. Braun, these observers plainly point out this as a case of true vegetable parthenogenesis. The stigma of the plant remains for a long time fresh, and even increases during the enlargement of the ovary. This is contrary to the ordinary phenomenon, when, after contact with the pollen, the stigma withers and dries up. This fact has also been confirmed by Messrs Naudin, Thuret, and Decaisne, in their observations on the production of seeds without fecundation, in the hemp, and *Mercurialis annua.*

As to the third question, whether *Cœlebogyne* has only one sex, it is stated that Sir William Hooker has in his herbarium male specimens collected by Allan Cunningham. These have been examined by Braun, and Decaisne, and have been found to possess normal stamens filled with perfect pollen.

It therefore appears that Cœlebogyne is a diœcious plant, which produces seeds by parthenogenesis, as well as by the agency of sexes. But we cannot at present conjecture what relation these two modes of reproduction bear to each other, and what is the bearing of parthenogenesis on the vital economy of the plant. If it is shown that without fecundation the plant only produces female individuals, which is the case in gardens at present, we may ask if this mode of multiplication is indefinite, or if it ceases after a determinate series of generations; or, finally, if, after a series of female generations, it will produce male individuals.

The other plants in regard to which parthenogenesis has been proved do not furnish any facts which can aid us in replying to these questions, seeing that their unfecundated seeds produce up to the fourth and fifth generations both male and female plants.

M. Braun thinks that parthenogenesis also can be shown to occur in some diœcious species of Chara, as in *Chara crinita.*

In Characeæ there exist reproductive organs of both sexes. In them sporangia and antheridia have been detected. Most of the Characeæ are monœcious, and some are diœcious. Among these diœcious species may be noticed *Chara aspera* and *crinita, Nitella syncarpa, capitata,* and *opaca.*

Chara crinita was first described and figured by Wallroth in 1815. This species is distinguished from all its congeners by the fact that the number of the series of cortical cellules of the stem is equal to that of the leaves which form a verticil, and the number of the same cellules in the leaves is equal to that of the secondary verticillate leaflets, which are usually called bracteæ; whilst in the other Charas the number is double or triple that of the parts which compose each verticil.

The geographical distribution of this species is less extensive than that of most of the others. It is found only in Europe, in Middle Asia, and in Northern Africa. It delights in saline or brackish water, and is found chiefly near the sea or in countries possessing salt springs, or ground impregnated with salt.

Although *Chara crinita* is said to be diœcious, yet we seldom can detect antheridia. M. Braun has in vain attempted to find these organs; and he arrives at the conclusion, that the *Chara crinita*, so far as he can ascertain, is usually represented only by female individuals, and that, nevertheless, it produces in abundance sporangia and fertile spores. M. Requien has very recently detected male plants at Courtheson, near Orange, and these, when examined, were found to bear antheridia. It would appear, then, that in certain localities the *Chara crinita* is represented by two sexes, whilst in general it is only represented by one.

The spores in the species of Chara follow the same development as in monœcious species, having both antheridia and sporangia.

Braun concludes that, on the supposition that the antheridia in Characeæ are true male organs, and that the antherozoids in them serve for fecundation, and that the spore formed in the sporangia is the true female organ, which is fertilized by contact with the antherozoids, he is justified in attributing to *Chara crinita* the power of producing, at least in certain localities, even without the action of male organs, perfectly-formed spores fit for germination, and that consequently this is a true case of parthenogenesis.

2. M. Auguste Trécul *on the Circulation of Plants.*

M. Trécul endeavours to show that the absorption by the roots, and the movements of fluids in plants, cannot be accounted for by capillarity and endosmose. Physiologists allow that these forces cannot carry the fluid to the summit of our trees without the aid of the evaporation from the leaves, which, as it were, draws the fluids to these organs. If evaporation makes the fluids ascend, Trécul thinks that it should prevent them from descending.

If we allow that endosmose causes the fluids to ascend by the wood and descend by the bark, then it follows that the density of the sap must go on augmenting in proportion as we ascend; it must increase in passing through the leaves from the woody part to the bark, and in descending from cell to cell in the interior of the cortical tissue. Mere gravity cannot account for the descent of the sap, when we reflect that the descent takes place in pendulous branches.

Botanists who admit the endosmotic theory have not considered that there must be two currents of fluids of different densities by the side of each other; that the ascending sap being less dense than the descending, must be attracted by the latter, since the membranes are permeable; that there must be throughout the whole length of the trunk a horizontal centrifugal current, until an equilibrium of density has been produced; and that then the double current of ascending and descending sap can no longer exist. The descending current, at least, would cease. Another force, therefore, seems to regulate the absorption of fluids from the soil, similar to that which regulates the absorption of gases from the atmosphere. Moreover, there are in plants other movements besides that of the ascending and descending sap. The sap communicates to the cells, during its progress, the substances required for their nutrition. The cells assimilate the matters which are suitable for them, and reject others. The rejected elements are taken up, according to Trécul, by the laticiferous vessels, or are collected into special reservoirs, as essential oils, &c. In these reservoirs there is not a denser fluid for which these oils have an affinity. Hence, then, endosmose seems to have no share in the movements.

The cellules on the surface of roots take up fluids by a vital force which we cannot explain, says Trécul. These fluids are carried to the woody parts of the root, and then of the stem; they reach the leaves, and then descend towards the roots, describing thus a kind of circle. This circulation may be called the *grand circulation;* while the *venous* circulation is that which, by means of the laticiferous vessels, carry back to the vessels, properly so called, the substances which the cells have not assimilated. There is, besides, an intra-cellular movement in many plants, to which the name of *rotation* has been given, as the fluid seems to perform a revolution with more or less regularity in the interior of each cell.

During vegetable life, all the fluids are in motion in each of the cells which compose the plant. Some cells take up the materials necessary for their growth or the formation of amylaceous, saccharine, and albuminous principles; other cells remove substances which have become useless and require to be eliminated, or matters which must be carried to other parts of the plant for cell-growth. This general movement constitutes the circulation. This name, however, is generally given to the more evident determinate currents which traverse the plant throughout its whole length.

The grand circulation consists, then, of an ascending and a descending current of sap. The ascent of sap takes place in the vessels which receive the liquids taken up by the roots from the soil. When the ascent commences, all the cells are in action. The nutritive substances which they contain are ready for assimilation. Starch, transformed into sugar by the action of diastase, is carried to those parts where it is required for cell-multiplication; the starch at the base of the buds goes to nourish them; that of the bark is conveyed into the interior of the cells of this organ. Under the influence of these nutritive matters increase in diameter commences by multiplication of cells. This cell-development at first takes place without the aid of the sap elaborated by the leaves, for we often find the cambium layers acquiring a considerable thickness before the leaves appear. The sap in ascending undergoes elaboration, and it contains certain matters fit for assimilation which may aid in the nutrition of the leaves and buds (in which the spiral vessels appear from below upwards).

The sap, after taking part in the nutrition of the first organs developed, reaches the leaves, where it is submitted to a new elaboration in their green parenchyma, as well as in the cellules of chlorophyll of the stems of fleshy plants without leaves. The carbonic acid of the air is absorbed, then decomposed during the day; its carbon is retained by the sap, and the greater part of its oxygen is evolved. The sap, modified under the influence of respiration, traverses the cortical cells, to which it imparts nourishment; it then contributes to the multiplication of cells of the generating layer, which increase in a horizontal direction. One part of the cells is multiplied horizontally, and forms a new layer of bark, ligneous fibres, and medullary rays; the others are transformed into vessels. The mode of formation of these vessels is as follows:—The excess of descending sap which is not used in the nourishment of the newly-formed cells, or in the thickening of those first formed, descends through certain of the newly-produced cells; it dilates them, perforates them, and makes them take all the characters of vessels.

This vascular formation takes place from above downwards, at the expense of the cells, which are multiplied in a horizontal series. This downward vascular formation has given rise to the idea that these fibres are the true roots of the buds or the leaves.

All the sap absorbed by the old and new cells, whether for their increase in length or thickness, or for the production of starch, albumen, and other matters required for after increase, is not used by the cells. A part only of its elements is assimilated, and the rest is thrown off. The latter, in the form of resin, essential oils, &c., is collected in particular reservoirs, whence it is poured out externally; or the non-assimilated matters are taken up by the laticiferous vessels, and are carried by them to the vessels properly so called (this is the venous circulation). There those substances which usually want oxygen are elaborated, oxidated under the influence of oxygen drawn from the air, and which reaches the vessels by the intercellular canals. Thus these matters become again fit for assimilation. From their oxidation results the carbonic acid given off during night, as well as that produced during the day, and decomposed in the leaves under the influence of light. The vessels formed by the descending sap serve during succeeding years for the ascent of the juices. They are filled with them so long as vegetation is very active, but are usually emptied by degrees as the fluids in the soil become less abundant.

M. Trécul has shown the course of the descending sap by means of ligatures round the stem, decortications, and other means. By such experiments sinuous vessels are produced; some parts of the vessels being vertical, others horizontal or oblique, according to the nature of the obstacles. These vessels are formed of cells elongated in a vertical direction—*i.e.*, parallel to the axis of the stem. The sinuosities of these vessels exhibit currents of sap moving through the cells of the generating layer, turning themselves in all directions in order to get an exit, perforating the cells from above downwards or horizontally, according as the current is vertical, oblique, or horizontal.

III. *Notice of a few Plants collected in the vicinity of Stirling, in August* 1857. By Dr George Lawson.

Among the rarer species may be noticed *Lysimachia Nummularia*, *Solidago Virgaurea*, *Epipactis latifolia*, *Circæa Lutetiana*, *Campanula latifolia*, *Lychnis Viscaria*, *Lamium album*, *Viola odorata*, *Veronica Anagallis*, *Calystegia Sepium*, *Œnanthe crocata*, *Astragalus glycyphyllus*, *Sedum anglicum*, *Hymenophyllum Wilsoni*, *Cystopteris fragilis*, *Asplenium*